DRAFT ANNEXES
to

COMMISSION REGULATION (EU) …/…

implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for household refrigerating appliances and low noise refrigerating appliances

repealing
Regulation (EC) No 643/2009 with regard to ecodesign requirements for household refrigerating appliances

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ANNEX I

**Definitions applicable for Annexes I to VI**

In addition to the definitions set out in Directive 2009/125/EC and the definitions set out in Article 1 of this Regulation, the following definitions shall apply:

1. ‘compartment type’ means the declared compartment type in accordance with the refrigerating performance parameters *Tmin*, *Tmax*, *Tc* and others as set out in Annex III, Table 3;
2. ’variable temperature compartment’, means a compartment intended for use as two (or more) alternative compartment types (e.g. a compartment that can be either a fresh food compartment or freezer compartment) and which is capable of being set by a user to continuously maintain the operating temperature range applicable for each compartment type claimed. A compartment intended for use as a single compartment type that can also meet storage conditions of other compartment types (e.g. a chill compartment that may also fulfil zero-star requirements) is not a variable temperature compartment;
3. ‘climate class’ means the range of ambient temperatures in which the appliances are intended to be used, and for which the required storage temperatures specified in Table 1 are to be met. There are four climate classes (with their acronym and ambient temperature range): ‘Extended Temperate’ (‘SN’ for +10 to +32 °C), ‘Temperate’ (‘N’ for +16 to +32 °C), ‘Subtropical’(‘ST’ for +16 to +38 °C) and ‘Tropical’ (‘T’ for +16 to +43 °C);
4. 'daily energy consumption' (*Edaily*) means the electricity used by a refrigerating appliance over 24 hours at reference conditions expressed in kWh/24h, as calculated in Annex IV.1.b on the basis of test procedures indicated in Annex III.4;
5. ‘annual energy consumption’ (*AE*) means the average daily energy consumption multiplied with 365 (days per year) expressed in kWh, as calculated in Annex IV.1.b;
6. ‘standard annual energy consumption’ (*SAE*) means the reference annual energy consumption of a refrigeration appliance expressed in kWh, as calculated in Annex IV.1.c;
7. ‘total average steady state power consumption’ (*Pss*) means the average power consumption in steady state conditions expressed in W, as determined in accordance with Annex III and Annex IV;
8. ‘auto-defrost’ means a feature by which compartments are defrosted without user intervention to initiate the removal of frost accumulation at all temperature-control settings or to restore normal operation, and the disposal of the defrosted water is automatic;
9. ‘manual defrost’ means not having an auto-defrost feature;
10. ‘defrost interval’ (*td-f*) means the representative average interval between the time of activation of the defrost heater, or the time of deactivation of the compressor if there is no defrost heater, in two subsequent defrost and recovery cycles expressed in h;
11. ‘incremental defrost and recovery energy consumption’ (*ΔEd-f*) means the extra average energy consumption for a defrost and recovery operation expressed in Wh, as determined in accordance with Annex III and Annex IV;
12. 'temperature rise time' means the time taken, after the operation of the refrigerated system has been interrupted, for the temperature in a 3- or 4 star compartment to increase from −18 to −9 °C expressed in h;
13. 'specific freezing capacity' (*x*) means the rate of heat extraction by an appropriately loaded refrigeration system, calculated as 12 times the light load weight, divided by the freezing time to bring the temperature of the light load from +25 to −18 °C at an ambient temperature of 25 °C expressed in kg/12h. The light load weight is 3,5 kg per 100 litre of freezer volume, and should be at least 2,0 kg;
14. ‘frozen compartments’ means the group of compartment types with a target temperature equal to or below 0°C, as set out in Annex III, Table 3;
15. 'fast freeze' means a reversible feature, to be activated by the end-user according to the manufacturer's instructions, which decreases the storage temperature of the freezer or freezer compartment to achieve a faster freezing of unfrozen foodstuffs;
16. ‘refrigerator-freezer’ means a combi that has at least one freezer compartment and one or more unfrozen or chill compartments, of which one fresh food compartment;
17. ‘winter switch’ means a control feature for a refrigerator-freezer with one compressor and one thermostat in the fresh food compartment, consisting of an appropriate sensory and switching device that activates or de-activates an artificial heat load in the fresh food compartment in order to guarantee, even if it would not be required for the fresh food compartment, that the compressor keeps on working to maintain the proper minimum temperature in the freezer compartment;
18. 'through-the-door device' means a device that dispenses chilled or frozen load on demand from a household refrigerating appliance, through an opening in its external door and without opening that external door. Examples are ice-cube dispensers or chilled water dispensers;
19. ‘unfrozen compartments’ means the group of compartment types with a target temperature equal to or above 4°C, as set out in Annex III, Table 3;
20. 'two-star section' means part of a three-star or four-star compartment which does not have its own individual access door or lid and in which the temperature is not warmer than −12 °C;
21. ‘minimum temperature’ (*Tmin*) means the minimum temperature inside a compartment during testing and relates to the minimum temperature for testing energy consumption (average over time and over a set of sensors) or the instantaneous values over the test period, as set out in Annex III, Table 3;
22. ‘maximum temperature’ (*Tmax*) means the maximum temperature inside a compartment during testing and relates to the maximum temperature for testing energy consumption (average over time and over a set of sensors) or the instantaneous values over the test period, as set out in Annex III, Table 3;
23. ‘target temperature’ (*Tc*) means the reference temperature inside a compartment c during testing as set out in Annex III, Table 3, and relates to the maximum temperature for testing energy consumption and is the average over time and over a set of sensors;
24. ‘chill compartment’ is a compartment type with performance requirements with a target temperature equal to 2°C, as set out in Annex III, Table 3;
25. ‘4-star’ means a rating for a freezer compartment that fulfils the storage conditions indicated in Annex III, Table 3 and also fulfils a minimum specific freezing capacity requirement that entails that the temperature of the light load is brought down from +25 to −18 °C within 24 hours. If the minimum freezing capacity cannot be guaranteed at all times within the ambient temperature operating range indicated by the manufacturer or importer, a 4-star rating does not apply;
26. ‘defrost and recovery period’ means the period from the initiation of a defrost control cycle until stable operating conditions are established;
27. 'average power consumption' (P) means the average rate of energy consumption of a refrigerating appliance for a specific test condition or operation expressed in Watts;
28. ‘temperature control cycle’ (TCC) means definite repetitive swings in temperature caused by operation of a temperature control device (on/off or otherwise). The period of a temperature control cycle is the time between a control event and its repetition on the next cycle. Where the control events cannot be discerned, the period of a temperature control cycle is the time between two successive temperature warmest points or two successive temperature coldest points. If no repetitive pattern can be distinguished, ‘fixed time slices’ can be used to establish whether steady state conditions are fulfilled;
29. ‘fixed time slice’ means a fixed length period of no less than a minimum number of hours as set out in Annex III.3(2) that may be used as an alternative to using TCCs in defining a block of test data, e.g. in case there are no discernible changes in temperature or power consumption over time;
30. ‘combi appliance’ means a refrigerating appliance that has more than one compartment type, except in the case of a freezer (3- or 4-star) compartment featuring also a two-star section or sub-compartment;
31. ‘dedicated appliance’ means a refrigerating appliance with only one type of compartment;
32. ‘thermodynamic factor’ (*rc*) means the temperature difference between the target temperature *Tc* of compartment c and the reference ambient temperature at +24 °C, expressed as a ratio of the same difference for a fresh food compartment at +4 °C, following the expression *rc =* (24−*Tc*)/20;
33. '*Mc' and 'Nc'* are parameters that take into account the volume-dependence of the energy use, with values as set out in Annex IV, Table 4;
34. 'auto-defrost factor'(*Ac*) means a compensation factor for frozen compartments, with values as set out in Annex IV, Table 4;
35. 'built-in factor' (*Bc*) means a compensation factor for built-in appliances, with values as set out in Annex IV, Table 4;
36. 'combi-factor’ (C) means a compensation factor for the energy consumption related to controlling the cooling of multiple compartment types; with values as set out in Annex IV, Table 4;
37. 'door heat loss factor' (*D*) means a compensation factor for combi-appliances with more than 2 doors with values as set out in Annex IV, Table 4;
38. 'load factor' (*L*) means a compensation factor for the extra cooling load from introducing warm foodstuffs beyond what is already anticipated through the higher average ambient temperature for testing with values as set out in Annex IV, Table 4;
39. ‘c’, means index number suffix for a compartment type in an appliance;
40. ‘built-in appliance’ means any household refrigerating appliance that is designed, intended, tested and marketed exclusively
* to be installed in cabinetry or totally encased (top, bottom, sides and back) by panels, and
* to be securely fastened to the sides, top or floor of the cabinetry or panels, and
* to be equipped with an integral factory-finished face or to be fitted with a custom front panel.

ANNEX II

Ecodesign requirements

The manufacturer shall establish conformity with this regulation based on the measurements and calculations described in Annex III and Annex IV respectively and following the definitions in Annex I and Article 2.

1. Energy efficiency index of household refrigerating appliances:
	1. From 1 April 2020, the energy efficiency index of refrigerating appliances shall not be above the values in Table 1:

*Table 1*

First tier maximum EEI of refrigerating appliances, expressed in %

|  |  |
| --- | --- |
|  | EEI |
| household refrigerating appliances, except for wine storage appliances | 125 |
| wine storage appliances | 155 |
| low noise refrigerating appliances | 300 |

* 1. From 1 April 2023, the energy efficiency index of household refrigerating appliance shall not be above the values in Table 2:

*Table 2*

First tier maximum EEI of refrigerating appliances, expressed in %

|  |  |
| --- | --- |
|  | EEI |
| household refrigerating appliances, except for wine storage appliances | 100 |
| wine storage appliances | 155 |
| low noise refrigerating appliances | 250 |

1. Product information:
	1. From 1 April 2020, the instruction manuals for installers and end-users, and free access website of manufacturers, their authorised representatives and importers shall provide the following product information, in the order as set out below:
		* + 1. the technical parameters set out in point (b);
				2. the compartment type(s);
				3. the compartment volume(s);
				4. the combination of drawers, baskets and shelves that result in the most efficient use of energy for the appliance;
				5. the recommended setting of temperatures in each compartment for optimum compromise between food preservation and energy consumption;
				6. where and how to store fresh foodstuffs and beverages in a refrigerating appliance for best preservation over a the longest period, to avoid food waste;
				7. an estimate of the impact of temperature settings on energy consumption;
				8. a description of the effects of special modes and features, and in particular how temperatures are affected in each compartment and for how long;
				9. for wine storage appliances, 'this appliance is intended to be used exclusively for the storage of wine';
	2. The technical documentation for the purposes of conformity assessment pursuant to Article 4 shall contain the following elements:
		* + 1. overall dimensions, expressed to the nearest millimetre, means space taken up by the refrigerating appliance (height, width and depth) with doors or lids closed;
				2. total volume of the appliance, in dm³ or litres rounded to the nearest integer, matching the sum of the compartment volumes in point c) hereafter;
				3. volume, in dm³ or litres rounded to one decimal place, per compartment, identified by the name and meeting the performance requirements of the compartment type as indicated in Annex III, Table 3. Variable temperature compartment will be identified separately with the compartment type characteristics for which it is declared to be suitable;
				4. target temperature, in °C rounded to the nearest integer, per compartment;
				5. for low noise refrigerating appliances ‘low noise refrigerating appliance’;
				6. for wine storage appliances ‘wine storage appliance’;
				7. climate class: SN, N, ST or T;
				8. minimum and maximum ambient temperature, in °C rounded to the nearest integer, for which the appliance is suitable;
				9. daily energy consumption, *E16C* and *E32C* in kWh/24h rounded to three decimal places;
				10. annual energy consumption, *AE* in kWh rounded to the nearest integer;
				11. standard annual energy consumption, *SAE* in kWh rounded to the nearest integer;
				12. total average steady state power consumption, *Pss* in W rounded to two decimal places;
				13. energy efficiency index EEI, number expressed in % rounded to the nearest integer;
				14. defrosting type, means the method to remove frost accumulation on the evaporator(s) of an appliance, distinguishing ‘auto-defrost’ or ‘manual defrost’;
				15. defrost interval control, meaning the control parameter that determines the interval between defrost cycles, distinguishing between ‘timer’, ‘compressor run-time’ or ‘variable defrost’, whereby the latter may be based on operational parameters (door-openings, inserting warm load) or direct measurement of frost accumulation;
				16. representative incremental defrost and recovery energy consumption, *ΔEd-f* in Wh rounded to one decimal place;
				17. defrost interval, *td-f* in h, at 16 and 32 °C ambient temperature, rounded to two decimal places;
				18. temperature rise time, in h rounded to hours and whole minutes;
				19. specific freezing capacity, *x* in kg/12h, rounded to one decimal place;
				20. winter switch present, yes/no;
				21. star rating in case of a frozen compartment with this feature as indicated in Annex III, Table 3;
				22. fast freeze in case of a frozen compartment with this feature as indicated in Annex III, Table 3;
				23. anti-condensation heater type ‘manual on-off’, ‘ambient controlled’, ‘other’ or ‘none’;
				24. airborne acoustical noise emissions expressed in dB(A) re1 pW, rounded to the nearest integer;
				25. individual measurement results for *Pss*, *ΔEd-f td-f* from valid test runs at 16°C and 32 °C ambient temperature for household appliances and at 25°C ambient temperature for low noise appliances;
				26. if applicable, interpolation or triangulation calculations to arrive at the assessment of *Edaily* per relevant ambient temperature.
2. Other:

From 1 April 2020:

* 1. a product shall not be designed so that its performance automatically alters in test conditions with the objective of reaching a more favourable level for any of the parameters specified in 2 or in any documentation provided with the product;
	2. gaskets shall be replaceable without special tools and manufacturers shall be able to supply end-users with fitting door gaskets for their household refrigerating appliances for at least 10 years after the production of the specific model has ceased. Relevant information for ordering these door gaskets, directly or through resellers, shall be supplied on the manufacturer’s website and in the booklet of instructions;
	3. the fast freeze facility, or any similar function achieved through modification of the thermostat settings in freezer compartments, shall, once activated by the end-user according to the manufacturer’s instructions, automatically revert to the previous normal storage temperature conditions after no more than 72 hours;
	4. Refrigerator-freezers with one thermostat and one compressor which according to the manufacturer's instructions can be used in ambient temperatures below + 16 °C and have a winter switch, shall have this winter switch automatically activated or de-activated according to the need to maintain the frozen food compartment at the correct temperature;

ANNEX III

Measurements and calculations

**A. Measurements**

For the purposes of compliance and verification of compliance with the requirements of this Regulation, measurements and calculations shall be made using harmonised standards the reference numbers of which have been published for this purpose in the *Official Journal of the European Union*, or other reliable, accurate and reproducible methods, which takes into account the generally recognised state-of-the-art methods. They shall fulfil the conditions and technical parameters set out in points 1 to 6 and in B. points 1 to 2.

1. General conditions for testing:

1. for refrigerating appliances with anti-condensation heaters that can be switched on and off by the end-user, the anti-condensation heaters shall be switched on and - if adjustable - set at maximum heating;
2. for refrigerating appliances with automatically controlled electric anti-condensation heaters, the automatically controlled electric anti-condensation heaters will be switched off or otherwise disabled, where possible, during the measurement of electricity consumption. The electricity consumption of these heaters will be calculated from their power consumption declared by the manufacturer for 10 humidity conditions and 3 ambient temperature conditions.
3. for refrigerating appliances with through-the-door devices that can be switched on and off by the end-user, the through-the-door devices shall be switched on during the energy consumption measurement but not operating;
4. for the measurement of energy consumption, variable temperature compartments shall operate as the compartment type which has the highest energy consumption;
5. for refrigerating appliances that can be digitally connected, this functionality shall not be disabled but there will be no active sending or receiving of data.
6. Assessment of volume:
	* 1. General:

The volume shall take into account the exact shapes of the walls including all depressions or projections.

When the volume is determined, internal fittings such as shelves, removable partitions, containers and interior light housings shall be considered as not being in place.

The volume of control housings, evaporator space, air ducts required for proper cooling and operation of the unit, the volume of any fixed or removable partition between compartments and sub-compartments, the space occupied by shelves moulded into the inner door panel shall be considered as being in place and their volumes deducted.

For through the door ice and water dispensers, the ice chute shall be included in the volume up to the dispensing function. The through the door ice and water dispensers and the insulating hump are not included in the volume. No part of the dispenser unit shall be included as volume.

* + 1. Volume of evaporator space:

The volume of the evaporator space shall be the product of the depth, width and height. The total volume to be deducted shall comprise the following:

in the case of a forced air evaporator, the total volume of the evaporator cover and behind the evaporator cover shall be deducted, including the volume occupied by the evaporator fan and the fan scroll;

in the case of plate style (e.g. roll-bond) evaporators, the volume behind vertically installed plate-style evaporators and the volume above horizontally installed plate -style evaporators if the distance between the horizontal plate -style evaporator and the nearest liner surface above is less than 50 mm. Removable drip trays/troughs shall be considered as not being present;

in the case of refrigerant filled shelving, the volume above the uppermost shelf and below the lowermost shelf, if the distance between the shelf and the nearest horizontal plane of the cabinet inner wall is less than or equal to 50 mm. All refrigerated shelves are considered as not present;

in case there is a fan installed in an unfrozen compartment with a refrigerated wall evaporator or a plate style evaporator, the volume of the fan.

* + 1. Two-star sections and/or compartments:

Two-star sections and/or compartments are permitted both in the door and in the remaining volume of a refrigerating appliance when all the following conditions are met:

the two-star section or compartment is marked with the appropriate identification symbol;

the two-star section and/or compartment is separated from the three-star of four-star volume by a partition, container, or similar construction;

the rated total two-star section volume does not exceed 20 % of the total volume of the compartment;

the instructions give clear guidance regarding the two-star section and/or compartment;

the volume of the two-star section and/or compartment is stated separately and is not included in the three-star or four-star volume.

1. Storage conditions and target temperatures per compartment type:

The following Table gives the storage conditions and target temperature per compartment type:

*Table 3*

Storage conditions and target temperature per compartment type

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Group** | **Compartment type** | **Note** | **Storage conditions** | ***Tc****note* ***[1]*** |
| ***Tmin*** | ***Tmax*** |
| *Name* | *Name* | *nr.* | *°C* | *°C* | *°C* |
| Un-frozen compartments | Pantry | ***[2]*** | +14 | +20 | +17 |
| Wine storage | ***[2][3]*** | +5 | +20 | +12 |
| Cellar | ***[2]*** | +2 | +14 | +12 |
| Fresh food | ***[2]*** | 0 | +8 | +4 |
| Chill compartment | Chill | ***[4]*** | −3 | +3 | +2 |
| Frozen compartment | 0-star & ice-making | ***[5]*** | *n.a.* | 0 | 0 |
| 1-star | ***[5]*** | *n.a.* | −6 | −6 |
| 2-star | ***[5][6]*** | *n.a.* | −12 | −12 |
| Freezer (3 and 4-star) | ***[5][6]*** | *n.a.* | −18 | −18 |
| *Notes:****[1]*** ***Tc*** relates to the target temperature for testing energy consumption and is the average over time and over a set of sensors. ***[2]*** ***Tmin*** and ***Tmax*** relate to average values measured over the test period (average over time and over a set of sensors) .***[3]***  The average temperature variation over the test period for each sensor shall be no more than ±0,5 K. During a defrost and recovery period the average of all sensors is not permitted to rise more than 1.5 K above the average value of the compartment. ***[4]*** ***Tmin*** and ***Tmax*** relate to instantaneous values during the test period.***[5]*** ***Tmax*** relates to average values measured over the test period (average over time and over a set of sensors). ***[6]*** During a defrost and recovery period, the maximum temperature of all sensors is not permitted to rise more than 3.0 K. n.a.=not applicable |

1. Energy consumption tests household refrigerating appliances:
	* 1. Introduction

The energy consumption of an appliance is determined from measurements taken when tested with appropriate test conditions in an ambient temperature of 32 °C and an ambient temperature of 16 °C. The value of the energy consumption shall be for a temperature control setting (or equivalent point) where all average compartment air temperatures are at or below the target temperatures specified in Table 1 for each compartment type claimed by the supplier. Values above and below target temperatures may be used to estimate the energy consumption at the target temperature for each relevant compartment by interpolation, as appropriate.

The main components of energy consumption to be determined are:

average steady state power consumption *Pss*, measured at 16 °C ambient temperature and measured at 32 °C ambient temperature;

incremental defrost and recovery energy *ΔEd-f*(in Wh) for products with one or more auto-defrost systems (each with its own defrost control cycle), the defrost and recovery energy for a representative number of defrost and recovery periods for each system shall be determined;

defrost interval *td-f* (in h) for products with one or more defrost systems (each with its own defrost control cycle), the defrost interval *td-f* (in h) shall be determined for each system under a range of conditions.

Throughout all tests the reference average ambient temperatures of 16 and 32 °C have to be maintained with a bandwidth of ± 0,5 K. On top of that, for steady state power consumption the test results will be corrected for smaller deviations from the reference. Note that for all compartments, the air temperatures of the compartment(s) will be measured and not the temperature inside ballasts. The appliance doors will remain closed and no warm load is introduced in the storage volume(s).

Each of these parameters will be determined through separate (sets of) tests. To improve the efficiency and accuracy of testing, the test period is not fixed, but is determined by whether a ‘steady state’ is reached.

Steady state is defined as a condition that occurs when test results comply with a series of acceptance criteria, laid down in an accurate, reliable and reproducible test method, to ascertain that stable test conditions occur. These acceptance criteria include that spread and slope of the average compartment air temperature and average power consumption between a minimum number of non-overlapping sampling periods or ‘blocks’ are within a specific narrow bandwidth. Furthermore there are rules as regards:

the minimum number of blocks;

position of the blocks (adjacent or not, distance to defrost and recovery period, depending on the purpose of the test);

minimum number of temperature control cycles (‘TCCs’) or minimum length in time per block (‘fixed time slices’ in case no repetitive patterns can be established);

repeatability (e.g. that a valid set of blocks of test data is preceded by a minimum number of also compliant set of blocks);

the type of compartments to measure in a combi-appliance;

how to extend the test data if the first test runs do not comply with the acceptance criteria.

Figure 1 gives an illustration of a typical compartment air temperature and electricity input for a refrigeration appliance:

*Figure 1*

Illustration of a typical compartment air temperature and electricity input for a refrigeration appliance



* + 1. Steady state power consumption
			- 1. Manual Defrost

For manual defrost products using a TCC-based test procedure, the acceptance criteria and rules for steady state energy consumption include:

a minimum number of 3 adjacent blocks of an equal number of TCCs (at least 1 TCC per block);

a minimum test period (6h);

a maximum spread across blocks for temperature (0,25K) and power consumption (varies between 1% for a 12h test period and 3% for a test period of 36 hours or more, with linear interpolation in between);

a maximum slope between the first and last block for temperature (0,025 K/h) and power consumption (less than 0,25%/h).

A valid steady state test period can start only after already two successive test-periods, each containing three blocks, meet the above criteria. In case of multi-compartment appliances, the temperatures relate to those in the largest frozen and the largest unfrozen compartment or –in case all compartments are either all frozen or all unfrozen—the largest two compartments.

In case of using ‘fixed time slices’ for testing of manual defrost products, the minimum test period is 12h, the maximum power spread is always 1% independent of the test period. The other acceptance criteria are the same as for appliances tested using TCCs.

* + - * 1. Auto defrost

For auto-defrost appliances also the manual defrost method can be used to establish the steady state energy consumption. Only in case it is difficult to find a valid steady state energy consumption in between defrost and recovery periods two separate blocks may be used, each ending at the start of a defrost and recovery period. Each block shall contain at least 4 TCCs and one block should not be 25% longer or shorter than the other. In case of fixed time slices the blocks shall be no less than 4 h in length and blocks must have equal lengths. If the time between defrost and recovery periods exceeds 48 hours, the start of the second block may be selected after this 48 h period. The maximum allowed average temperature spread between the blocks is 0,5 K. The maximum allowed spreads in power consumption shall be less than 2 % (relative spread) or less than 1 W (absolute spread), whichever is the greater value.

* + 1. Incremental defrost and recovery energy consumption

For auto-defrost appliances the incremental defrost and recovery energy *ΔEd-f* is established by finding two valid steady state blocks, following steady state acceptance criteria similar to those mentioned in Section 4.(2), one before and one after the defrost and recovery period. The reference point for defrost and recovery period is 2 h after the (first) activation of the defrost heater. The end of the first block is 3 h before and the start of the second block is 3 h after this reference point. Each block contains at least 3 TCCs or has a fixed length of 3 h. The start of the first block shall be no less than 5 h after the initiation of the previous 'defrost heater on' or, in the case where there is no defrost heater, no less than 5 h after the interruption of the refrigeration system related to the automatic defrost. The second block shall not overlap with the subsequent defrost and recovery period.

Note that if these initial start, stop and interval values do not deliver an acceptable result they can be shifted.

The relevant test period runs from the start of the first block until the end of the second block, i.e. with the defrost and recovery period in between. The total energy consumption during this test period is measured. Subsequently, the total energy consumption for that period is calculated as if it were the steady state energy consumption, based on the steady state power measured in the two steady-state blocks. The difference between the two is the incremental defrost and recovery energy consumption.

The test(s) shall be done at least for each temperature control setting. The defrost and recovery period selected for each temperature control setting shall be adjacent to the steady state period used for energy determination. In case there is more extensive test data, the average of at least 4 defrost and recovery incremental energy consumption data, for each control setting, shall be used. In this case at least 50 % of all values of *ΔEdf* shall have the coldest compartment at or below target temperature. A separate value for *ΔEdf* shall be determined for each ambient temperature.

* + 1. Defrost and recovery frequency and interval

There are three methods of defrost interval control, meaning the control parameter that determines the interval between defrost cycles, distinguishing between ‘timer’, ‘compressor run-time’ or ‘variable defrost’, whereby the latter may be based on operational parameters (door-openings, inserting warm load) or direct measurement of frost accumulation.

For the timer-control, which is relatively rare, the interval can be measured directly. Values for at least three defrost intervals shall be determined, with at least one value at an ambient temperature of 16 °C and one value at an ambient temperature of 32 °C.

For the compressor run-time control, the past run-time of the compressor is used as a proxy for the door-openings and inserted warm load.

For the compressor run-time control, the interval can be measured directly. Tests shall be undertaken over a whole defrost control cycle, at least one at each ambient temperature, in order to verify that it is a run time controller and estimate the value of the interval. Complementary test at e.g. other ambient temperatures and/or temperature control settings are required to check consistency of the interval with the compressor run time. The coefficient of variation (standard deviation divided by the mean) of the estimated values for compressor run time shall be less than 10 % for the defrost intervals examined; otherwise the controller shall be qualified as a ‘variable defrost’ controller.

For a variable defrost controller the interval is calculated on the basis of values specified by the manufacturer for *Δtd−max*maximum possible defrost interval at an ambient temperature of 32 °C and *Δtd−min* minimum possible defrost interval at an ambient temperature of 32 °C, both expressed in hours.

The value for Δtdf16 at an ambient temperature of 16 °C shall be double the value of the defrost interval Δtdf32 for an ambient temperature of 32 °C.

*Δtd−min* shall not exceed 12 h at an ambient temperature of 32 °C (elapsed time). *Δtd−max*shall not exceed 96 h at an ambient temperature of 32 °C.

*Δtd −mi*n shall be based on the shortest conceivable defrost interval under heavy usage conditions (i.e. heavy use, frequent door openings and high humidity) at an ambient temperature of 32 °C. Tests under heavy usage conditions to verify the claimed value may be undertaken. The value for *Δtd−max*shall be achievable under test conditions with compartment temperatures at or below target temperatures in steady state. Manufacturers shall specify any special condition required to achieve the claimed value.

In case the manufacturer does not supply declared values for *Δtd−min* and *Δtd−max*, default values of 6 h for *Δtd−min* and 96 h for *Δtd−max* shall be used, resulting in a *Δtdf32* of 24 h and a Δtdf16 of 48 h.

If, apart from the manufacturer not declaring the values, the verification test shows the operation not consistent with a variable defrost controller then the averages of 3 defrost intervals at both 16 and 32°C ambient is measured and used as values for *Δtdf16* and *Δtdf32* respectively, whereby *Δtdf16* shall not exceed 20 h and *Δtdf32* shall not exceed 10 h.

1. Energy consumption tests low-noise refrigerating appliances:

Energy consumption of low-noise appliances shall be tested only at an ambient temperature of 25 °C. Low-noise appliances have no auto-defrost and thus the tests only determine the steady state power consumption *Pss25*. Otherwise, the test procedure is identical to that of dedicated cellar or pantry household appliances.

1. Performance of chill compartments:

In order to avoid loopholes in the declaration of chill compartments, as defined in Table 3, the following additional requirements apply:

* 1. for a variable temperature compartment rated as fresh food and/or chill, the energy efficiency index shall be determined for each temperature condition and the highest value shall be applied;
	2. a chill compartment shall be able to control its average temperature during energy testing within a certain range without user-adjustments of its control; this shall be verified as follows:
		+ 1. determine the reference chill compartment temperature *Tccma,ref* by performing an energy consumption test at 32°C ambient. *Tccma,ref* is the interpolated value of T*ccma* [[1]](#footnote-1) (e.g. found at the interpolated fresh food compartment T*ma* =4°C),
			2. perform an energy consumption test at 16°C. *Tccma* shall be within *Tccma,ref±1,5K* for any setting used for interpolation, with the limitation that the fresh food compartment *Tma* shall be in the range from 2 to 6°C.

**B. Calculations**

1. For household refrigerating appliances
	* 1. Energy Efficiency Index EEI:

The Energy Efficiency Index EEI compares the Annual Energy consumption AE (in kWh/a) with the reference Standard Annual Energy consumption SAE (in kWh/a) and is calculated as:

;

the outcome is a dimensionless number, usually expressed as a percentage (%).

* + 1. Annual Energy consumption AE:

The Annual Energy consumption *AE* of a household refrigerating appliance is based on the measurements according Section A at two ambient test temperatures, 16 and 32°C, regarding:

steady state power consumption *Pss* (per ambient temperature *Pss16*, *Pss32*) in W;

the incremental defrost energy consumption *ΔEd-f* (per ambient temperature *ΔEd-f16* and *ΔEd-f32*) in Wh;

defrost and recovery interval td-f in h (per ambient temperature *td-f16* and *td-f32*).

The average daily energy consumption *Edail*y in kWh/24h is calculated from values at both ambient test temperatures *E16C* and *E32C* as follows:

*Edail*y = (*E16C* + *E32C*);

with *E16C* = 0.001 ∙ 24 ∙ (*Pss*16 + *ΔEd-f16* / *td-f16*) and;

*E32C* = 0.001 ∙ 24 ∙ (*Pss32* + *ΔEd-f32* / t*d-f32*).

The values for *E16C* and *E32C* may result from two or three point interpolations of outcomes from several test-runs.

The Annual Energy consumption AE in kWh/a is as follows:

*AE* = 365∙( *E16C* + *E32C*)∙0,5.

* + 1. Standard Annual Energy consumption SAE:

The Standard Annual Energy consumption *SAE* of a household refrigerating appliance is based on the type(s) and volume(s) of the compartments *Vc* (in dm³ or litres, with one decimal), its total volume *V* (in dm³ or litres, rounded to the nearest integer) and a series of parameters given in Table 4.

The Standard Annual Energy consumption *SAE*, in kWh/a, is calculated as follows:

;

where c is the compartment index suffix and n is the total number of compartment types.

Note that for the variable temperature compartments the compartment type with the lowest target temperature is chosen for which it is declared suitable.

*Table 4*

Default values of parameters per compartment type in the calculation of EEI

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Compartment type** | ***rc*** | ***Nc*** | ***Mc*** | ***Ac*** | ***Bc*** | ***C*** | ***D*** | ***Lc*** |
| *Name* | - | - | - | - | - | - | - | - |
| Pantry | 0.35 | 75 | 0,12 | 1,00 | 1,04 | between 1,15 and 1,56 forrefrigerator-freezers*a*, 1,15 for other combis,1,00 for dedicated appliances | 1.02, 1.035, 1.05 for 3,4 or more than 4 doors | 1,00 |
| Wine storage | 0.6 |
| Cellar | 0.6 |
| Fresh food | 1.00 |
| Chill | 1.1 | 138 | 0,12 | 1,06 |
| 0-star & ice-making | 1.2 | 138 | 0,15 | 1,10 | 1,10 |
| 1-star | 1.5 |
| 2-star | 1.8 |
| Freezer (3- and 4-star) | 2.1 | 0,9 if dedicated |
| a *C* for refrigerator-freezers is determined as follows:where *frzf* is the freezer volume *Vfreezer* as a fraction of total volume with *frzf*=*Vfreezer/V*: * if *frzf*≤0,3 then *C*=1,3+0,87∙*frzf*;
* else if 0,3<*frzf*<0,7 then *C*=1,89−1,1∙*frzf;*
* else *C*=1,15.
 |

1. Calculation methods for low-noise refrigerating appliances

The Energy Efficiency Index *EEI* (expressed in %) is calculated as above, i.e.:

*EEI=AE/AEC.*

Basis for the assessment of the energy consumption of low noise refrigerating appliances is the steady state power consumption at a single ambient temperature of 25 °C *Pss25* (in W), measured in accordance with Section A.5.

The daily energy consumption *Edaily25* at 25°C ambient temperature (in kWh/24h) is given by:

*Edaily25 = 0,001 ∙ 24 ∙ Pss25.*

The annual energy consumption *AE* (in kWh/a) is given by:

*AE* = 365 *∙ Edaily2.*

Low noise appliances are manual defrost (*Ac*=1), stand-alone (*Bc*=1), dedicated (*C*=1), single door (*D*=1) appliances with cellar (*rc*=0,6 ) or pantry (*rc*=0,35 ) compartment type as defined in Tables 3 and Table 4. The latter implies *Nc*=75 and *Mc*=0,12 and *L*=1. The Standard Annual Energy consumption *SAE* (in kWh/a) can thus be simplified as follows:

* for cellar types: *SAE*= 75 + *V* ∙ 0,6 ∙ 0,12 = 75 + 0,072*V;*

for pantry types: *SAE*= 75 + *V* ∙ 0,35∙ 0,12 = 75 + 0,042*V.*

ANNEX IV

Verification procedure

The verification tolerances defined in this Annex relate only to the verification of the measured parameters by Member State authorities and shall not be used by the manufacturer or importer as an allowed tolerance to establish the values in the technical documentation or in interpreting these values with a view to achieving compliance or to communicate better performance by any means.

When verifying the compliance of a product model with the requirements laid down in this Regulation pursuant to Article 3(2) of Directive 2009/125/EC, for the requirements referred to in this Annex, the authorities of the Member States shall apply the following procedure:

1. the Member State authorities shall verify one single unit of the model;
2. the model shall be considered to comply with the applicable requirements if:
3. the values given in the technical documentation pursuant to Directive 2009/125/E, Annex IV, point 2, and, where applicable, the values used to calculate these values, are not more favourable for the manufacturer or importer than the results of the corresponding measurements carried out pursuant to paragraph (g) thereof; and
4. the declared values meet any requirements laid down in this Regulation, and any required product information published by the manufacturer or importer does not contain values that are more favourable for the manufacturer or importer than the declared values; and
	* 1. when the Member State authorities test the unit of the model, the determined values (the values of the relevant parameters as measured in testing and the values calculated from these measurements) comply with the respective verification tolerances as given in Table 5;
		2. if the results referred to in point(b)(1) or (2) are not achieved, the model and all models that have been listed as equivalent household refrigerating appliance models in the manufacturer's or importer's technical documentation shall be considered not to comply with this Regulation;
		3. if the result referred to in point (b)(3) is not achieved, the Member State authorities shall select three additional units of the same model for testing. As an alternative, the three additional units selected may be of one or more different models that have been listed as equivalent models in the manufacturer's or importer's technical documentation;
		4. the model shall be considered to comply with the applicable requirements if, for these three units, the arithmetical mean of the determined values complies with the respective verification tolerances given in Table 5;
		5. if the result referred to in point (e) is not achieved, the model and all models that have been listed as equivalent household refrigerating appliance models in the manufacturer's or importer's technical documentation shall be considered not to comply with this Regulation;
		6. the Member State authorities shall provide all relevant information to the authorities of the other Member States and to the Commission without delay after a decision being taken on the non-compliance of the model according to points (c) and (f);

The Member State authorities shall use the measurement and calculation methods set out in Annex III.

The Member State authorities shall only apply the verification tolerances that are set out in Table 5 and shall only use the procedure described in points (a)to (g) for the requirements referred to in this Annex. No other tolerances, such as those set out in harmonised standards or in any other measurement method, shall be applied for parameters in Table 5.

*Table 5*

Verification tolerances

|  |  |
| --- | --- |
| Parameters | Verification tolerances |
| Volume | The determined value shall not be less than the declared value by more than 3 % or 1 litre, whichever is the greater value. Where the volumes of the cellar compartment and the fresh food storage compartment are adjustable, relative to one another, by the user, the volume shall be tested when the cellar compartment is adjusted to its minimum volume. |
| Freezing capacity | The determined value shall not be less than the declared value by more than 10 %. |
| Energy consumption | The determined value shall not exceed the declared value of the annual energy consumption *AE* by more than 10 %. |

ANNEX VI

Benchmarks

The best available technology on the market, at the time of entry into force of this Regulation, for the environmental aspects that were considered significant and are quantifiable is indicated below.

At the time of entry into force of this Regulation, the best available technology on the market for household refrigerating appliances in terms of their Energy Efficiency Index EEI and noise was identified as follows. The figures in brackets indicate the previous EEI-value according to the repealed Commission Regulation (EC) 643/2009.

**Household refrigerating appliances:**

Dedicated fresh food appliance (‘refrigerator’):

Large: EEI= 57% [18], V=309 litre, AE=70 kWh/a

Table-top: EEI= 63% [22], V=150 litre, AE=71 kWh/a

Dedicated wine storage appliance (no glass door)

Insulated door: EEI=113% [33], V=499 litre, AE=111 kWh/a

Glass door: EEI=140% [42], V=435 litre, AE=133 kWh/a

Refrigerator-freezer:

EEI=59% [18], V=343 litres (223/27/93 litres for fresh-food/chill/freezer), AE=146 kWh/a

Dedicated freezer appliance:

Upright Small: EEI=52% [20], V=103 litre, AE=95 kWh/a

Upright Medium: EEI=63% [22], V=206 litre, AE=137 kWh/a

Chest: EEI=55% [22], V=230 litre, AE=116 kWh/a

Lowest noise reported (of all models): 34-35 dB(A)

**Low-noise refrigerating appliance** (dedicated cellar or pantry appliance):

Insulated door: EEI=233% [73], V=30 litre, AE=182 kWh/a

Transparent door: EEI=330% [102], V=40 litre, AE=255 kWh/a

Low noise appliances are reported to be ‘noisseless’ (noise power <15 dB(A) according to current test standards)

1. *T ccma* = The time averaged chill compartment temperature is the integrated time average of the instantaneous average chill compartment temperature (*Tcca*) or the arithmetic average of the integrated time averaged chill compatment temperatures (*Tccim*) (both methods give the same result). The suffix ‘cc’ indicates that *Tma*, *Tim*and *Ta* relate to a chill compartment type. [↑](#footnote-ref-1)